Hypothesizing the Outcome of the EFA Goal No. 6 for 2015: A Deductive Consequence of a Proposed Quality Instruction

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ABSTRACT

This is a descriptive study which uses hierarchical cluster analysis to group 17 teacher respondents to establish similarity of their characteristics in terms of procedural and conceptual knowledge, and their ability to examine errors in procedure and reasoning. The data suggested that conceptual and procedural knowledge plus the ability to correct misconception are important in increasing the likelihood of quality instruction. The Quality instruction index suggests that respondents have a surface level conceptual knowledge. These limited conceptual knowledge of the respondents affected their assessment. It was hypothesized that the Education for All (EFA) goal no. 6 of improving all aspects of the quality of education and ensuring excellence for 2015 cannot be achieved.

Keywords: cluster analysis, conceptual knowledge, procedural knowledge, quantitative model, quality instruction

I. Introduction

Many promising endeavors have been explored in order to model what constitute effective learning and teaching. One is Lee Shulman's Pedagogical Content Knowledge (PCK). PCK is an amalgam of teachers' content knowledge (CK) of the subject and the pedagogical knowledge (PK), in teaching the subject (e.g. Hill, Ball & Schilling, 2008; Cochran, 1991; The 2011 Praxis Client Conference). The first, CK includes knowledge of the subject and its organizing structures (Grossman, Wilson, & Shulman, 1989; Shulman, 1986b, 1987; Wilson, Shulman, & Richert, 1987, qtd. in Loewenberg-Ball, Thames, & Phelps, 2008) and the latter, PK is general pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter (Hill, Ball & Schilling, 2008). Shulman offered seven Types of Knowledge of Teachers as seen below.

Shulmans' Type of Knowledge: (a) General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organization that appear to transcend subject matter; (b) Knowledge of learners and their characteristics; (c) Knowledge of educational contexts, ranging from workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; (d) Knowledge of educational ends, purposes, and values, and their philosophical and historical grounds; (e) Content knowledge; (f) Curriculum knowledge, with particular grasp of the materials and programs that serve as "tools of the trade " for teachers; and (g) Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their own special form of professional understanding (Shulman, 1987, p. 8; quoted by Ball et al., 2008, p. 391, in The 2011 Praxis Client Conference). To this end, Shulmans PCK in the teaching field can be simply modeled in Figure 1.

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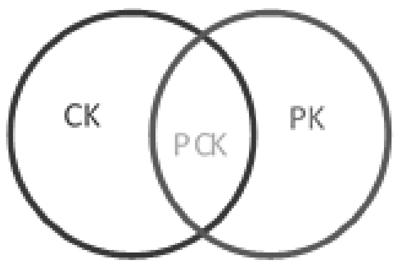

Figure 1. PCK as The Blending of CK and PK

This conceptualization explains PCK as the blending of what the teacher knows about the subject being taught and the bank of pedagogies known. Shulman and his colleagues considered PCK as unique to teachers, and are based on the manner in which what are known about teaching is linked to what are known about what the teacher teaches. In other words, an expert and efficient teacher's knowledge is organized from a teaching perspective and is used as a basis for helping students to understand specific concept.

Understanding specific concept can be affected by many factors. Gagani and Misa (in press) believed that the quality of cognition that includes remembering and reasoning is dependent on the quality of knowledge at hand. That is superficial knowledge hinders the transfer of that knowledge to new task. Similar to this point, Cochran, DeRuiter, and King (1993) whom they revised Shulman's PCK also placed emphasis on the importance of students' prior knowledge in learning. Their PCK model is the integration of four major components, namely: (a) subject matter knowledge; (b) pedagogical knowledge; (c) teachers' knowledge of students' abilities and learning strategies, ages and developmental levels, attitudes, motivations, and prior knowledge of the concepts to be taught; and (d) teachers' understanding of the social, political, cultural and physical environments in which students are asked to learn.

Learning outcome depends heavily on the teacher. In the review made by the Horizon Research (2010) two studies reported a direct linked between teachers' content knowledge and teaching practice. One study regarding this matter found that the more knowledgeable teacher presented problems in context that were familiar to the children in the classroom and linked them to activities they had previously completed. This implied that knowledgeable teacher in terms of content is a better pedagogics in terms of connecting students prior knowledge to new ones. The second one reported that stronger content knowledge were more likely to respond to students' mathematical ideas appropriately, and to make fewer mathematical or language error during instruction. The opposite is true, that is the lack of content knowledge seems to limit teachers instruction. Below are drawn theoretical consequences from the reports:

a. Teacher can impart and impact learning through his knowledge underpinnings of the subject matter and pedagogy.

b. Knowledge Underpinnings serves as language whereas pedagogy as mode in discovering error in reasoning and computing and correcting.

c. Knowledge underpinnings on the subject matter and pedagogy are requirements in understanding and delivering instructional materials respectively. Below is a theoretical configuration of these deductions.

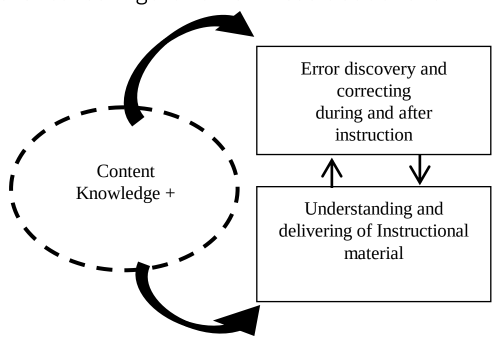

Figure 2. Content knowledge and pedagogy

The theoretical deductions explains that if a teacher has a limited understanding of the subject matter can oppress understanding to students' thinking and error detection to students understanding is less probable. In the case that teacher is more knowledgeable but pedagogy is not appropriate to the students' current level of understanding may detect error but correcting may not be successful. This goes in similar fashion to the understanding of instructional materials and how it should be delivered.

While the studies have reported the impact of content knowledge to instruction, this study did present what constitutes quality instruction. To this point, we came with a proposed concept of what constitute better quality instruction (BQI). Below is our simple combinatorial model of what constitute BQI:

Given:

A= Teachers' Content Knowledge Structure (TCKS)

B= Pedagogical Knowledge (PK)

C= Knowledge of Students Cognitive Condition (KSCC)

D= Right Instructional Material (RIM)

$$BQI = TCKS \cap PK \cap KSCC \cap RIM$$

In our conceptualization of what is better quality instruction, one factor say, teachers' knowledge structure of the subject is not organized will hamper teaching and learning for the students at the core of instruction. On one hand, without the right pedagogy and understanding of student's present cognitive condition, that is the students' own knowledge structure is futile. Additionally, right instructional material serve as one ingredient in the building of concept and is believed by us as requirement in the processing of information, hence without the proper IM, will also obstruct learning. Dauda, Jambo, and Umar (2016), noted that senior secondary students perceived that instructional material, teacher qualification and the methods used in teaching were determinants of their success in learning mathematics . We claim that in the absence of one of these ingredients will lessen the quality instruction (LQI) with which fourteen possible scenarios may occur during classroom instruction. Below is the conceptualization of our claimed:

Conceptualizations:

$LQI_{1} = (B\ \ C\ \ D) - A$

$LQI_{2} = (A\ \ C\ \ D) - B$

$LQI_{3} = (A\ \ B\ \ D) - C$

$LQI_{4} = (A\ \ B\ \ C) - D$

$LQI_{5} = (A\ \ B) - (C\ \ D)$

$LQI_{6} = (A\ \ C) - (B\ \ D)$

$LQI_{7} = (A\ \ D) - (B\ \ C)$

$LQI_{8} = (B\ \ C) - (A\ \ D)$

$LQI_{9} = (B\ \ D) - (A\ \ C)$

$LQI_{10} = (C\ \ D) - (A\ \ B)$

$LQI_{11} = A - (B\ \ C\ \ D)$

$LQI_{12} = B - (A\ \ C\ \ D)$

$LQI_{13} = C - (A\ \ B\ \ D)$

$LQI_{14} = D - (A\ \ B\ \ C)$

It is not the purpose of this study, to quantify and provide empirical evidence to all fourteen possible situations during instruction and its effect on instruction and students performance, rather the purpose of this study is to predict possible outcome through one of our models about the Education for All (EFA) goal no. 6 of 2015 (UNESCO, 2010-2015) of improving all aspects of the quality of education and ensuring excellence of all so that recognized and measurable learning outcomes are achieved by all like numeracy. The prediction is a deductive consequence of the teachers' Quality Instruction in the elementary level with the focus on their procedural and conceptual knowledge in operating fractions and their ability to examine faulty reasoning. We have chosen these basic mathematical domain in mathematics since elementary mathematics education provides the foundation of learning mathematics in the junior high and senior high levels in the Philippine K to 12 education paradigm. Difficulty learning in this area can hamper learning in algebra (Booth, Newton, & Garrity, 2014). Similarly, Bailey, Hoard, and Nugent, (2012) reported that procedural fluency with fraction predicts 7th grade mathematics achievement whereas understanding fraction magnitude and general mathematics achievement with 6th and 8th graders are correlated (Torbeyns, Schneider, Xin, & Siegler, 2015).

The rationale here is that pupils who received poor instruction to this area will have a less probable learning to happen as they proceed to another area bringing a domino effect of poor learning in high school mathematics. It is through quality instruction that better learning takes place.

Actually, we have observed that most high school students had difficulty in operating fraction and in communicating with numbers in the public school setting. We will be predicting possible outcome through $LQI_{10} = (C\ \ D) - (A\ \ B)$. We assume that variable A and B are available. From the conceptualized variables, the absence of one is considered less quality. By this purpose, our study will provide backbone for future reference that might be helpful in making educational policy and planning.

II. OBJECTIVES

This study predicts the outcome of the EFA goal no. 6 in the Philippine context. Specifically, the study determines the procedural and conceptual knowledge levels and the ability to examine errors in operation of fractions (addition, multiplication, and division) and traces elementary teachers pedagogic skill in teaching fraction. Through one of our own model of LQI (lesser quality result to less quality), the educational outcomes can be deductively predicted.

III. METHODOLOGY

Research Locale. This study was conducted in one of the cities in the Philippines. The city is considered as one of the highly developed cities in the province of Cebu. The data were gathered from the nine (9) selected elementary public schools in Lapu-Lapu City.

Respondents. The 9 participating elementary schools out of 30 were chosen randomly. Some of these schools are within the city area and some are situated in the city's islands. All respondents were general education graduates who teach basic math in the elementary years. Table 2 shows the distribution of the respondents per chosen school. The number of participating schools and respondents are reasonable enough because it can already provide a counterexample that is suited for the EFA goal no. 6. (Improving all aspects of the quality of education and ensuring excellence of all so that recognizable and measurable learning outcomes are achieved by all, especially in literacy, numeracy and essential life skills.

Table 1
Distribution of respondent per participating school

School	f		∑
	male	female	
School A	1	0	1
School B	1	1	2
School C	1	0	1
School D	1	0	1
School E	2	1	3
School F	3	0	3
School G	2	1	3
School H	1	1	2
School I	1	0	1
∑	**13**	**4**	**17**

Research Instruments. A three (3) part questionnaire was used to gather data of the respondents.

Part A is a self- constructed four-item test. It determines the respondent's procedural and conceptual knowledge in operation (Addition, Multiplication and division) of fractions. The items in Part B are collated from the related studies. It determines the respondents' problem solving skills as application of addition and subtraction of fractions.

Finally the third part provides data of their pedagogical knowledge in teaching fractions. Item 1 and 2 evaluates the respondents' assessment skills in identifying misconception and knowledge in providing immediate feedback and clarification of that misconception. In item 1 of part C, gathers information on how teachers addresses students' misconception of improper and proper fraction. Item 2 of C examines teacher's ability to identify students' misconception of multiplication of fraction. Generally part in part C, expectations from the teachers were; understanding students' current cognitive condition in their conceptions or reasoning, creating solutions to eliminate students' false conception and reasoning, being able to ask appropriate questions to understand students' thought, forming appropriate criteria for assessment and assessing students' answers according to these criteria.

Criteria for problem C1 are:

a. Understanding students' misconception
b. Understanding the reason(s) of students' misconception
c. Creating solutions to remove students' misconception

Criteria for problem C2 are:

a. Understanding students' misconception
b. Understanding the reason(s) of students' misconception
c. Creating solutions to remove students' misconception
d. Asking appropriate questions to reveal misconception

To ensure that the content of the questionnaire answers the desired purpose of this study, the researchers let experts checked and scrutinized the self-made questionnaire. The following experts were two (2) mathematics major teachers who earned units in Doctor of Philosophy in Research and Evaluation and three (3) other who were holder of Master of Arts in Mathematics. Content Validity Index (CVI) was computed and gained an average CVI of 0.90 (acceptable value).

The reliability of the questionnaire was tested to establish its stability. The researchers conducted the test-retest reliability to the ten (10) mathematics teachers. These mathematics teachers were not part of the actual respondents of the study. Their responses were analyzed using the correlation coefficient and gained a coefficient of 0.82 (acceptable reliability coefficient).

IV. FRAMEWORK

Qualitative Framework. We qualitatively describe $LQI_{10} = (C \cap D) - (A \cap B)$ in this manner. Consider a teacher X who is teaching mathematics. Assuming that teacher X has knowledge on Students Cognitive Condition (KSCC), say addition of dissimilar fraction is difficult for the class to perform. Let us also consider that teacher X has right Instructional Material (RIM) in teaching. But teacher X conceptual understanding of fraction is limited and lacks pedagogical knowledge in teaching improper fraction. The possible outcome is that the instruction is less in quality. Hence, conceptual understanding affects procedural understanding. Teacher X will introduced addition of fraction without sense. Additionally, teacher X may find difficulties in using the RIM effectively since it contains elements that needs more sophisticated conceptual networks of ideas.

Our idea here is that when a teacher lacks the conceptual understanding of the topic, it will lessen educational outcome. Figure 3 presents this idea.

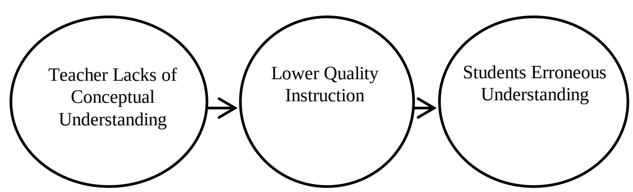

Figure 3. Impact of Lack of Conceptual Understanding to Teaching

The figure theoretically configures the effect of limited conceptual understanding to a subject matter being taught to the students. It leads to erroneous acquisition of that knowledge which is eventually the result of the kind of instruction.

Quantitative Framework. From our general model of QI below:

OI = TCKS $\cap$ PK $\cap$ KSCC $\cap$ IM, we computed the indexes of TCKS, PK, and KSCC as follows:

(1) TCK for procedural knowledge in Test A
(2) Let assume the following groups (X_{in}) represents:

X_1 is the group of teachers who correctly operated item 1;
X_2 is the group of teachers who correctly operated item 2;
X_3 is the group of teachers who correctly operated item 3; and
X_4 the group of teachers who correctly operated item 4; then by addition principle the following combination holds true;
$X_1 \cap X_2 \cap X_3 \cap X_4$ is the group who correctly operated the four items;
$X_1 \cap X_2 \cap X_3$ is the group who correctly operated items 1, 2, and 3;
$X_1 \cap X_2 \cap X_4$ is the group who correctly operated items 1, 2, and 4;
$X_1 \cap X_3 \cap X_4$ is the group who correctly operated items 1, 3, and 4;
$X_2 \cap X_3 \cap X_4$ is the group who correctly operated items 2, 3, and 4;
$X_1 \cap X_2$ is the group who correctly operated items 1, 2;
$X_1 \cap X_3$ is the group who correctly operated items 1 and 3;
$X_1 \cap X_4$ is the group who correctly operated items 1 and 4;
$X_2 \cap X_3$ is the group who correctly operated items 2 and 3;
$X_2 \cap X_4$ is the group who correctly operated items 2 and 4;
$X_3 \cap X_4$ is the group who correctly operated items 3 and 4;
$X_1 - X_2 - X_3 - X_4$ is the group who correctly operated item 1 only;
$X_2 - X_1 - X_3 - X_4$ is the group who correctly operated item 2 only;
$X_3 - X_1 - X_2 - X_4$ is the group who correctly operated item 3 only;
$X_4 - X_1 - X_2 - X_3$ is the group who correctly operated item 4 only; thus

Index for Item 1 of A= number of teachers who computed successfully/total number of respondents expressed in percentage.

The TKS index for procedural knowledge is the average of the indexes of the four items modeled as:

(1) $$TCK_{Proc}\text{Index}=\frac{X_1+X_2+X_3+X_4}{4}$$

TCK for conceptual knowledge in Test A.

(1) Let assume the following groups (Y_{in}) as explained with the right mathematical concepts in Test A.
(2) Y_1 explained correctly how to answer item 1;
Y_2 explained correctly how to answer item 2;
Y_3 explained correctly how to answer item 3; and
Y_4 explained correctly how to answer item 4; then the following combination also holds true;
$Y_1 \cap Y_2 \cap Y_3 \cap Y_4$ explained correctly how to answer the four items
$Y_1 \cap Y_2 \cap Y_3$ explained correctly how to answer items1, 2, and 3;
$Y_1 \cap Y_2 \cap Y_4$ explained correctly how to answer 1, 2, and 4;
$Y_1 \cap Y_3 \cap Y_4$ explained correctly how to answer items1, 3, and 4;
$Y_2 \cap Y_3 \cap Y_4$ explained correctly how to answer items 2, 3, and 4;
$Y_1 \cap Y_2$ explained correctly how to answer items 1, 2;
$Y_1 \cap Y_3$ explained correctly how to answer items 1 and 3;
$Y_1 \cap Y_4$ explained correctly how to answer 1 and 4;
$Y_2 \cap Y_3$ explained correctly how to answer items 2 and 3;
$Y_2 \cap Y_4$ explained correctly how to answer items 2 and 4;
$Y_3 \cap Y_4$ explained correctly how to answer items 3 and 4;
$Y_1 - Y_2 - Y_3 - Y_4$ explained correctly how to answer item 1 only;
$Y_2 - Y_1 - Y_3 - Y_4$ explained correctly how to answer item 2 only;
$Y_3 - Y_1 - Y_2 - Y_4$ explained correctly how to answer item 3 only;
$Y_4 - Y_1 - Y_2 - Y_3$ explained correctly how to answer item 4 only; thus the index for the TKS for conceptual knowledge is computed using the model below.

Index for Item 1_c of A_c = number of teachers who explained correctly /total number of respondents expressed in percentage.

The TCK index for procedural knowledge is the average of the indexes of the four items modeled as:

(2) $$TCK_{Con}\text{Index}=\frac{Y_1+Y_2+Y_3+Y_4}{4}$$

The TCK index of test A is the average of the indexes of the TCK_{con} and TCK_{proc}.

(3) $$\mathrm{TCKS}_A \text{ Index}=\frac{TCK_{proc}index+TCK_{con}index}{2}$$

TCK for procedural and conceptual knowledge in Test B.

To quantify the procedural knowledge in solving problems involving fraction, the same procedures were applied, thus

(4) $$\mathrm{TCK}_{\mathrm{Procprob}} \text{ Index}=\frac{\text{numberofcorrectprocedures}}{\text{numberofrespondent}}$$

(5) $$\mathrm{TCK}_{\mathrm{conprob}} \text{ Index}=\frac{\text{numberofcorrectprocedures}}{\text{numberofrespondent}}$$

The TCKS index is the average of the indexes of the $\mathrm{TCK}_{con(A,B)}$ and $\mathrm{TCK}_{proc(A,B)}$.

(6) $$\text{CKS Index}=\frac{TCK_{proc(A,B)}index+TCK_{con(A,B)}index}{2}$$

Quantification of the teachers KSCC. To quantify the teachers knowledge on students cognitive condition, we used similar analysis procedure in TCKS. To recall Test 2 consist of three situations that measures teacher's ability to know the students cognitive condition, thus:

$$\text{KSCC Index}=\frac{Index_a+Index_b+Index_3}{3}$$

Finally, the better quality instruction index was reported as:

QI index = TCKS index + KSCC index PK index + IM index

In the computation we assume that teacher respondents have a bank of strategy and have correct IM. The rationale here is that we just wanted to know the effect of TCKS and KSCC in instruction. Thus;

QI index = TCKS index + KSCC index PK + IM

V. METHODOLOGY

Data gathering. The researchers asked permission to the Schools Division Superintendent in Lapu-Lapu City in gathering data.

After its approval the researches then went to the respective participating school wherein elementary teachers who teaches mathematics where directly referred by the school principal. After answering the questionnaire, the data are then checked, tabulated and analyzed.

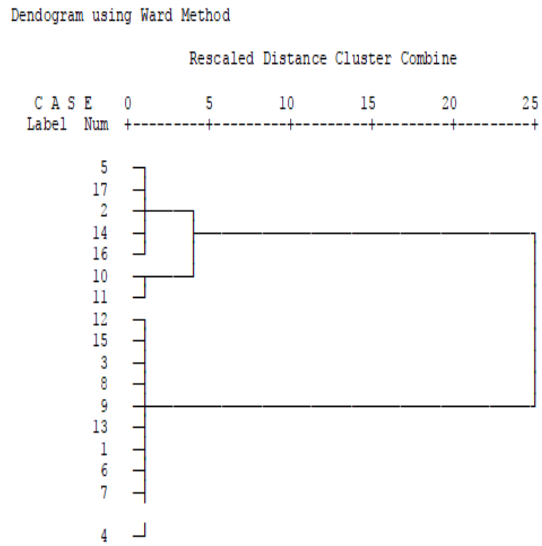

Figure 4. Cluster of teacher respondents

Two clusters were reported through similarity measures. Teachers 5, 17, 2, 14, 16, 10 and 11 belong to one cluster and Teachers 12, 15, 3, 8, 9, 13, 1, 6, 7 and 4 belong to the other cluster.

Clustering of the respondents. Through a software, the respondents were grouped according to Wards Method algorithm and squared Euclidean similarity measures. Figure 4 presents the dendrogram of the clusters.

There are only two clusters considered in the study for the dendrogram indicated only two major categories. Each category shows identical performance of its elements.

Modeling and Computation of indexes. After clustering the respondents, the respected indexes of the variables in this study was computed and compared for analysis and for the characterization of their knowledge and ability to see errors and make necessary corrections.

VI. RESULTS

Table 2
Procedural Index

Content Measured	Cluster 1	Cluster2
Addition of Similar Fractions	100%	100%
Addition of Dissimilar Fractions	100%	100%
Multiplication of Similar Fractions	100%	100%
Division of Similar Fractions	100%	100%
Mean Index	100%	100%

Table 3
Conceptual Index

Content Measured	Cluster 1	Cluster 2
Addition of Similar Fractions	33.33%	33.33%
Addition of Dissimilar Fractions	33.33%	33.33%
Multiplication of Similar Fractions	33.33%	33.33%
Division of Similar Fractions	33.33%	33.33%
Mean Index	33.33%	33.33%

Table 3 shows the Teachers Conceptual Knowledge. Table 4 shows the overall content knowledge in operating fraction. Table 5 summarized the teacher's problem solving ability involving fractions. Table 6 below was the overall index of teachers' content knowledge. Table 8 shows the Quality Instruction Index.

Table 4
Teachers Content Knowledge Index in Test A

Cluster	Knowledge Type		x̄
	Procedural	Conceptual	
1	100%	33.33%	66.67%
2	100%	33.33%	66.67%

Table 5
Teachers Problem Solving Skills

Item no.	Cluster 1		Cluster 2	
	Procedural Skill	Conceptual Underpinnings	Procedural Skill	Conceptual Underpinnings
1	57.14%	19.05%	0.00%	0.00%
2	100.00%	33.33%	60.00%	20%
x̄	79%	26.19%	30.00%	10%
General x̄	52.56%		20.00%	

Table 6
Overall Index of Teachers' Content Knowledge

Test	Cluster 1	Cluster 2
A	66.67%	66.67%
B	52.56%	20.00%
x̄	59.62%	43.34%

VII. Discussion

1. Content Knowledge structure and knowledge on students cognitive functioning are optimal in use if it increases quality instruction to near to near or equal to 100 that is when a teacher has good content knowledge and is able to know how student think on a certain task increases the chance of giving correct input to students and is able to correct erroneous reasoning exposing students to a high quality of instruction.
2. Cluster 2 is the group where many teachers have shown more content knowledge than cluster 1. Although both clusters, performed in the same manner in procedural approach, but the first group have more facilities than the latter in solving simple problems involving fractions. Gagani and Misa (in press) have noted that the quality of knowledge governs taught processes, like for example, connecting and communicating the knowledge acquired to new information to complete a task.

Table 8
Quality Instruction Index of the Two Clusters

Cluster	QI	TCKS	KSCC
1	43.70%	59.62%	27.78%
2	21.67%	43.34%	0%

3. Cluster 1 show a little understanding of students miss conception however is not seen to impact quality instruction. This may imply that teacher respondents in this study have not fully grasps the important concepts in operating fraction. For example in item 2 of test C, many cluster 1 teachers threated the procedure of the doer as the commonly known "cross multiplication" by multiplying the numerators and denominators leading to the misconception that the doer reasoning is incorrect. However, some justified that it is correct but did not explain logically. Actually, there is nothing wrong with the procedures.
4. Cluster 2 was seen to have an impoverished conceptual understanding of operation of fractions. This means that cluster 2 teachers have mastered the algorithm, without having a good grasp of its conceptual underpinnings.
5. In totality, it was observed that having a good content knowledge on a topic and the ability to know students own knowledge structure are vital in the instruction process as it provides facility to the teacher in assessing and correcting student's mistakes. Additionally, it was further observed that the ability to

Table 7
Teachers' Knowledge on Determining Students Cognitive Functioning Index

Cluster	Category	Item 1						Item 2						Index
		Point												
		1		2		3		1		2		3		
		f	%	f	%	f	%	f	%	f	%	f	%	
1	(a.)Understanding Students' Misconception	5	71.43%	0	0%	0	0%	7	100.00%	0	0%	0	0%	**28.57%**
	(b.)Understanding the reason(s) of students' Misconception	5	71.43%	0	0%	0	0%	7	100.00%	0	0%	0	0%	**28.57%**
	(c.) Creating solutions to remove students' Misconception	4	57.14%	0	0%	0	0%	7	100.00%	0	0%	0	0%	**26.19%**
	General Index	**14**	**66.67%**	**0**	**0%**	**0**	**0%**	**21**	**100.00%**	**0**	**0%**	**0**	**0%**	**27.78%**
2	(a.)Understanding Students' Misconception	0	0.00%	0	0%	0	0%	0	0.00%	0	0%	0	0%	**0.00%**
	(b.)Understanding the reason(s) of students' Misconception	0	0.00%	0	0%	0	0%	0	0.00%	0	0%	0	0%	**0.00%**
	(c.) Creating solutions to remove students' Misconception	0	0.00%	0	0%	0	0%	0	0.00%	0	0%	0	0%	**0.00%**
	General Index	**0**	**0.00%**	**0**	**0%**	**0**	**0%**	**0**	**0.00%**	**0**	**0%**	**0**	**0%**	**0.00%**

know faulty reasoning and procedures is affected by prior content knowledge.

VIII. CONCLUSION

Content Knowledge and knowledge on cognitive condition impact among groups of teachers in their quality instruction. The more knowledgeable is the teacher and the more he is able to know the students reasoning the better is the chance of having a better classroom instruction. However, increasing content knowledge alone or the capacity to determine faulty reasoning and algorithms is not enough. Both TCKS and KSCC should be considered as prime modals as it leads to a better quality of instruction. It is suggested then, that teachers must enrich their knowledge in the conceptual domain of mathematics. Nevertheless, the ability to examine errors is likewise proposed to be developed. The low Quality instruction index suggest that the EFA goal no. 6 of Improving all aspects of the quality of education and ensuring excellence of all so that recognized and measurable learning outcomes are achieved in numeracy by 2015 is not achievable.

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REFERENCES

Bailey, D. H., Hoard, M. K., Nugent, L., & Geary, D. C. (2012). Competence with fractions predicts gains in mathematics achievement. *Journal of Experimental Child Psychology*, 113(3), 447-455.

Ball, D. L., Lubienski, S., & Mewborn, D. (2001). Research on Teaching Mathematics: The unsolved problem of Teachers' Mathematical Knowledge. In V. Richardson (E.D), *Handbook of Research on Teaching* (4th ed.) New York: McMillan

Booth, J. L., Newton, K. J., & Twiss-Garrity, L. K. (2014). The impact of fraction magnitude knowledge on algebra performance and learning. *Journal of Experimental Child Psychology*, 118(1), 110-118.

Cochran,W. G. (1991). *Teknik Penarikan Sampel*. Penerbit Indonesia: Universitas Indonesia.

Cochran, K., DeRuiter, J. & King, R. (1993). Pedagogical content knowing: An integrative model for teacher preparation, *Journal of Teacher Education*, 44 (4), 263-272

Dauda, B., Jambo, H. E., & Umar, M. A. (2016). Students' Perception of Factors Influencing Teaching and Learning of Mathematics in Senior Secondary Schools in Maiduguri Metropolis, Borno State, Nigeria. *Journal of Education and Practice*, 7(20), 114-122.

Gagani, R. F. & Misa, R. (in press). SOLO based-cognition levels of inductive reasoning in Geometry. *Alberta Journal of Educational Research*.

Grossman, P. L., Wilson, S. M., & Shulman, L. S. (1989). Teachers of substance: Subject matter knowledge for teaching. Profesorado, *Revista de Currículum y Formación del Profesorado*, 9(2), 1-25.

Hill, H. C., Ball, D. L., & Schilling, S. G. (2008). Unpacking pedagogicalcontent knowledge: Conceptualizing and measuring teachers' topic specific knowledge of students. *Journal for Research in Mathematics Education*, 39(4), 372-400

Loewenberg-Ball, D., Thames, M. H., & Phelps, G. (2008). Content knowledge for teaching: What makes it special? *Journal of Teacher Education*, 59(5), 389-407.

Shulman, L. (1987). Knowledge and teaching: Foundations of the new reform. *Harvard Educational Review*, 57(1), 1-22.

The 2011 Praxis Client Conference. *Content Knowledge for Teaching: Innovations for the Next Generation of Teaching Assessments*.

Torbeyns, J., Schneider, M., Xin, Z., & Siegler, R. S. (2015). Bridging the gap: Fraction understanding is central to mathematics achievement in students from three different continents. *Learning and Instruction*, 37(1), 5-13.

Wilson, S. M., Shulman, L. S., & Richert, A. E. (1987). '150 different ways' of knowing: Representation of knowledge in teaching. In J. Calderhead (Ed.). *Exploring teachers' thinking* (pp. 104-124). London: Cassell.

United Nations Educational, Scientific, and Cultural Organization (2010-2015). Education for All Goals. Retrieved from http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/education-for-all/

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